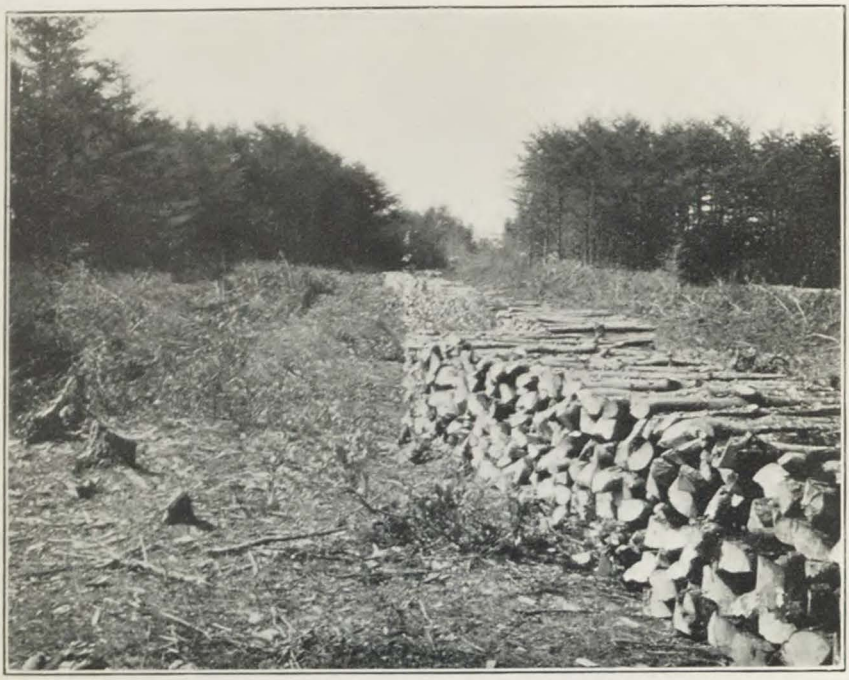

FIG. 1.—TWENTY-FIVE TO THIRTY YEAR OLD STAND CLEAN CUT FOR FUEL, YIELDING ABOUT 30 CORDS PER ACRE.

FIG. 2.—FORTY-FIVE TO FIFTY YEAR OLD STAND CLEAN CUT FOR BOX BOARDS, YIELDING 20,000 FEET OF 1-INCH BOARDS PER ACRE. CHARACTERISTIC PERSISTENCE OF LIMBS, RESULTING IN LOW-GRADE LUMBER.

PURE, EVEN-AGED, WELL-STOCKED STANDS OF SCRUB PINE.

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HENRY S. GRAVES, Forester.

SCRUB PINE.

(*Pinus virginiana.*)

BY

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LETTER OF TRANSMITTAL.

UNITED STATES DEPARTMENT OF AGRICULTURE,
FOREST SERVICE,
Washington, D. C., April 5, 1911.

SIR: I have the honor to transmit herewith a manuscript entitled "Scrub Pine," by W. D. Sterrett, Forest Assistant, and to recommend its publication as Bulletin 94 of the Forest Service.

Respectfully,

HENRY S. GRAVES,
Forester.

Hon. JAMES WILSON,
Secretary of Agriculture.

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ILLUSTRATIONS.

Fig. 1.—Twenty-five to thirty-year-old stand clean cut for fuel, yielding about 30 cords per acre. Fig. 2.—Forty-five to fifty-year-old stand clean cut for box boards, yielding 20,000 feet of 1-inch boards per acre ..... Frontispiece.

SCRUB PINE.

INTRODUCTION.

Scrub pine yields only inferior timber, but the abundance of the tree, especially as second growth on old fields and waste land, the ease with which it reproduces itself, and its ability to thrive on sterile soils, such as clays and marls, where no other species will grow, make it important throughout its commercial range. It offers an important problem of woodlot management in several eastern States, especially in Maryland and Virginia, where it has taken possession of many thousands of acres of idle farm land.

NOMENCLATURE.

The botanic name of scrub pine is *Pinus virginiana* (Mill). The species has a dozen or more common names, of which the most frequently used after scrub pine are spruce pine and jack pine. It is called spruce pine mostly in the Coastal Plain region, where it grows with loblolly, while in the mountains, where it grows with white pine, it is usually known as jack pine. The species is also known by the following names in various parts of the country: Jersey pine, shortshucks or shortshat pine, shortleaved pine, cedar pine, river pine, nigger pine, oldfield pine, bastard pine, second-growth pine, and poverty pine. Often it is known by several names in one locality, according to its presence as small second-growth or as large and mature trees.

DISTINGUISHING CHARACTERISTICS.

Scrub pine can readily be distinguished from the other yellow pines by its general appearance and by its leaves, cones, and bark. Two needles are borne together in a sheath; they are from 1 to 2½ inches in length, always have a decided twist, and are only slightly rigid. The cones are broad and sessile and from 1½ to 2½ inches in length. Many cones cling to the trees for several years after shedding their seeds, so that frequently a tree is covered with cones of different ages. The bark of the tree is thin, scaly, and much thinner than that of most yellow pines. Even on the largest trees it is very seldom as much as three-fourths of an inch thick, and usually less than one-half inch. On the trunks of small poles it is one-eighth to one-fourth inch in thickness. It is dark brown in color, with a slightly reddish tinge, and it is divided by shallow fissures into thin, scaly plates. On

large trees the fissures in the bark of the trunk are rather wide and deep, and the bark in the crowns is smooth and a yellowish red.

Pitch, loblolly, and shortleaf, the pines which are most frequently associated with scrub pine, are easily distinguished from it. Pitch and loblolly pines have three needles in a sheath, and their needles and cones are much longer; shortleaf has smaller cones and two or three needles, which are somewhat longer than those of scrub pine, rigid and straight, and lack the characteristic twist of scrub pine.

DISTRIBUTION AND OCCURRENCE.

The natural range of scrub pine is from Staten Island in New York to Blount and Winston Counties in northern Alabama and from the Atlantic coast to southern Indiana. In the northern part of its range it is found near the coast, but southward it grows at a constantly increasing distance from the sea, until, in northern Alabama, it occurs only in the mountains.

Its natural range indicates that scrub pine is best adapted to climates where the thermometer seldom falls below zero in winter or rises above 100° F. in summer, where the growing season is not extremely long, and where there is abundant rainfall combined with a high average humidity.

It is not adapted to a very sandy soil, such as dunesands along the coast. It thrives best on a clay or loam, or a sandy loam. It is possible to extend the range of scrub pine considerably farther north or south. It has, for example, been grown in the Arnold Arboretum in Cambridge, Mass., where it has borne good seed. It is excluded from certain climates to the South not unfavorable to its growth largely by the competition of other species still better adapted to those climates.

DISTRIBUTION IN THE DIFFERENT STATES.

In New York scrub pine grows on Staten, Long, and Middle Islands, but never in pure stands of commercial importance. In New Jersey the species occurs scatteringly through the southern two-thirds of the State, where it occasionally forms pure groves of small extent, especially in Cumberland County. Its occurrence in the State is principally on the central Cretaceous formation, where the soils consist of marls, clays, and sandy clays. In this section of the State scrub pine and shortleaf pine are the most common coniferous trees. Scrub pine has been noticed as far north as Union, Somerset, and Hunterdon Counties, where the geological formation is Triassic and the underlying rocks are red sandstone, shale, and trap. On the area of very sandy soil in southeastern New Jersey scrub pine does not occur, and pitch pine is the prevailing tree.

Scrub pine has a botanical range through the southern half of Pennsylvania, where it occurs naturally on sterile tops of hills and ridges less than 1,000 feet in elevation. In several localities it has

taken possession of abandoned farm land, and forms pure groves of some extent. It is not commercially important for lumber, owing to its small size and limited quantity. Its principal uses in the State are for mine props and lagging and for pulp wood.

The species occurs in all three counties of Delaware, but in commercial quantities only in the southwestern corner of Kent County and in the western portion of Sussex. It has some slight commercial importance for lumber in this State.

In Maryland scrub pine has considerable commercial importance. It is found in all the counties of the State. It grows, to some extent, in the original forest, but its predominating growth is on the old fields. This old-field growth is most abundant in Charles, St. Marys, Prince Georges, Anne Arundel, Caroline, and Dorchester Counties. The second growth is used chiefly for fuel, box boards, pulp wood, and charcoal, and the old growth for lumber.

In Virginia and North Carolina scrub pine is found in the Piedmont Plateau region and in the mountains below an elevation of 3,000 feet, but in the Coastal Plain region it occurs only in the northern part of Virginia. It frequently forms pure stands of considerable extent on abandoned fields. In second-growth it tends to supplant shortleaf pine in the Piedmont region and white pine in the mountains. These stands are extensive and are becoming of considerable commercial importance.

In West Virginia it can be found in every county and wherever there is pine. It is seldom large enough for lumber, but is extensively used for fuel and mine props.

The northern and mountainous part of South Carolina, Georgia, and Alabama forms the southern limit of the range of the species. Here it has, for the most part, only a scattered botanical distribution, and is not commercially important. It has an extensive range in Tennessee and Kentucky, and is found in all but the western fourth of these States. It is here of some commercial importance for fuel and rough lumber for local uses. It grows also in the southeastern corner of Indiana and in the southern half of Ohio, only occasionally reaching dimensions suitable for saw timber.

VIRGIN FOREST.

In virgin forests throughout its range scrub pine grows almost exclusively on the least fertile soils and in dry, exposed situations. The natural sites for the species seem to be on sterile clay soils and on gravelly and sandy land. It occurs in two types of virgin forests, (1) on dry pine ridges, in mixture with other pines, and (2) on dry southern and western exposures, in mixture with hardwoods and other pines. On account of its comparatively slow growth after it has reached an age of 50 or 60 years, its short life, and its intolerance of shade, it is seldom found on the better sites in the virgin forest.

After a severe windfall on a good site the area may be seeded up to scrub pine. But the type thus formed is temporary; the scrub pine will eventually be crowded out and the original type reestablished. The species can hold its own only on the poorer sites, to which it is especially adapted, and on this account it never forms extensive pure stands in the virgin forests. Where it occurs in the pine-ridge type it sometimes constitutes more than 50 per cent of the stands, while in the mixed hardwood and pine type it seldom forms over 25 per cent.

SECOND GROWTH.

The variety of sites on which scrub pine occurs, as well as the total area of land occupied by the species, has been greatly increased by the interference of man in the culling and clearing of forest land. This is due to its superior reproductive power, which results in the increase of the proportion of scrub pine after lumbering, especially where the logging is close. Even where there is no scrub pine in the original mixture, severely logged hardwood and white pine slopes are often seeded up to scrub pine from seed trees situated on the pine ridge above. The proportion of scrub pine in the second growth which follows logging is usually greater than in the original forest, yet it never succeeds in forming large pure stands on lumbered areas. Fires immediately after lumbering tend to favor the reproduction and to increase the proportion of scrub pine in the new growth, but coming later are likely to be very destructive to seedlings already established.

The species reproduces best on abandoned farm land and there forms extensive pure stands. The second growth on old fields is of more importance than the original growth in virgin or culled forests, because it is greater in amount. This old-field growth has sprung up on farm land abandoned during and since the Civil War, and most of it is under 50 years old.

FORM AND DEVELOPMENT.

Scrub pine under 15 years in age normally has a long, regular, narrow, conical crown, and a straight undivided stem covered with branches nearly to the ground. With advancing age the lower branches die and drop off and the crown gradually becomes shorter and wider—first broadly conical, then rounded, and finally short, flat, broad, and irregular. Its form is dependent principally on the age of the individual tree and the density of the stand in which it has grown. It is also affected by the quality of the soil on which the tree is growing.

OPEN STANDS.

Where the stand is so open that the trees receive full sunlight on all sides, they develop wide-spreading, thick-branched, low crowns

nearly as broad as the trees are high, and very short trunks. Such trees are useful only for cordwood or for protecting the soil. They make prolific seed trees, and several of them on an acre of unused farm land will furnish seed for a dense growth.

DENSE STANDS.

It is desirable to develop trees which at maturity will be tall, with straight, clear, smooth boles, and dense, even-aged stands will produce this form. The greater the density of the stand the more desirable is the form of each tree in it. The constant suppression of the lower branches concentrates the growing energy of the tree in its terminal shoot, so that the maximum height growth is attained. Scrub pine is inferior to most other yellow pines in self-pruning ability, so that density of stand is especially necessary.

GROWTH OF FULLY STOCKED STANDS.

A large part of the old-field growth of scrub pine consists of dense, fully stocked stands, practically even aged, and almost pure. Such stands, and the individual trees composing them, have a normal and regular growth.

Stands not fully stocked show great variations in yield, according to the degree of density. To secure the best development scrub-pine stands must have enough seedlings, and evenly enough distributed, so that the stand will be closed up when from 6 to 8 years old—that is, the crowns touching each other on all sides and the ground fairly well shaded.

Table 1 shows the average development and yield of fully stocked stands on old fields in Maryland.

TABLE 1.—*Stand and yield per acre at different ages, Montgomery and Prince Georges Counties, Md.*[1]

Age.	Number of trees per acre.			Yield per acre.			
	Total.	Trees 5 to 9 inches diameter, breast high.	Trees 10 inches and over diameter, breast high.	Including top and stump.	Firewood.	Pulp wood.	Trees 5 inches and over.
Years.				*Cubic feet.*	*Cords.*	*Cords.*	*Board ft.*
10	3,790	.....	.....	.....	.....	.....	.....
15	2,510	60	.....	1,280	12.8	.....	720
20	1,470	275	.....	2,010	20.1	.....	5,790
25	885	380	.....	2,510	25.1	.....	9,590
30	625	395	5	2,990	29.9	26.0	11,850
35	490	370	25	3,450	34.5	30.0	13,600
40	420	330	45	3,900	39.0	33.9	15,070
45	380	290	70	4,290	42.9	37.3	16,440
50	370	250	90	4,650	46.5	40.4	17,700

[1] This table is based on 39 sample plots that averaged one-third of an acre each. The yield in cords was calculated from the yield in cubic feet, 1 cord of firewood being computed to be equal to 100 cubic feet and 1 cord of pulp wood equal to 115 cubic feet. The board-feet measurements were obtained by scaling trees 5 inches and over, breast-high diameter, by a mill tally table for white pine, subtracting 10 per cent, and plotting a curve.

The table shows how the number of trees in the stand decreases with increase in age. At 80 years, stands with more than 100 trees to the acre are rare, and at this age the stand has become uneven and undergrown with hardwoods.

GROWTH OF SINGLE TREES.

The growth of single trees in diameter, height, and volume varies with age, the amount of growing space, and the quality of the site. In open stands the rate of diameter growth is more rapid than in dense stands, but a lesser height growth is attained and the volume growth for the whole stand is usually less, while the timber is far inferior in quality. Table 2 shows the rate of growth in diameter, height, and volume of average dominant trees in fully stocked stands.

TABLE 2.—*Growth of trees on old fields in Montgomery and Prince Georges Counties, Md.*[1]

Age.	Average diameter, breast high.	Maximum diameter, breast high.	Height.	Total volume.	Age.	Average diameter, breast high.	Maximum diameter, breast high.	Height.	Total volume.
Years.	*Inches.*	*Inches.*	*Feet.*	*Cu. ft.*	*Years.*	*Inches.*	*Inches.*	*Feet.*	*Cu. ft.*
5....	0.4	0.8	6	.....	35....	7.2	9.4	51	8.4
10....	2.4	3.8	17	0.2	40....	7.8	10.1	55	11.1
15....	3.8	5.6	26	1.0	45....	8.4	10.8	59	14.4
20....	4.8	6.8	33	2.5	50....	9.0	11.4	63	18.4
25....	5.7	7.8	40	4.3	55....	9.6	12.1	.....	23.1
30....	6.5	8.6	46	6.2	60....	10.1	12.8	.....	.....

[1] Basis: 104 average dominant trees selected from 39 sample plots.

Single trees grown in dense stands sometimes reach the dimensions of good-sized timber trees. The species, as a rule, is short lived, and 150 years is about its age limit. Three feet in diameter and 125 feet in height may be considered the maximum dimensions attained by the species, but trees more than 18 inches in diameter and 100 feet high are rare.

Tables 3, 4, and 5 show the merchantable volume of scrub pine in board feet, in fuel cords, and in cords of peeled pulp wood.

TABLE 3.—*Merchantable volume of scrub pine, in board feet, Montgomery and Prince Georges Counties, Md.*[1]

Diameter, breast high.	Height.	Volume.	Diameter, breast high.	Height.	Volume.	Diameter, breast high.	Height.	Volume.
Inches.	*Feet.*	*Board ft.*	*Inches.*	*Feet.*	*Board ft.*	*Inches.*	*Feet.*	*Board ft.*
5	43	11	9	54	57	13	61	136
6	47	21	10	56	73	14	63	163
7	50	32	11	58	91	15	65	194
8	52	44	12	60	112			

[1] Equivalent to actual saw cut, since it was obtained by scaling trees of average height by Margolin's mill tally table for white pine, subtracting 10 per cent, and plotting a curve. This table is based on measurements of 242 trees.

TABLE 4.—*Volume of scrub pine in fuel-wood cords, Maryland.*[1]

Diameter, breast high.	Height (feet).													
	10	15	20	25	30	35	40	45	50	55	60	65	70	75
	Volume (cords).													
Inches.														
2	0.002	0.003	0.003	0.004	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
3	.....	.....	.006	.007	0.009	0.010	0.012	.....	.....	.....	.....	.....	.....	.....
4	.....	.....	.....	.....	.015	.017	.020	0.022	0.024	.....	.....	.....	.....	.....
5	.....	.....	.....	.....	.022	.026	.029	.033	.036	0.040	.....	.....	.....	.....
6	.....	.....	.....	.....	.....	.037	.042	.047	.052	.057	0.063	0.068	.....	.....
7	.....	.....	.....	.....	.....	.050	.057	.064	.072	.079	.087	.094	0.102	.....
8	.....	.....	.....	.....	.....	.....	.075	.085	.094	.103	.133	.122	.131	.....
9	.....	.....	.....	.....	.....	.....	.....	.105	.116	.128	.139	.151	.162	0.174
10	.....	.....	.....	.....	.....	.....	.....	.129	.141	.154	.166	.179	.192	.204
11	.....	.....	.....	.....	.....	.....	.....	.....	.168	.182	.196	.210	.225	.238
12	.....	.....	.....	.....	.....	.....	.....	.....	.....	.210	.226	.241	.257	.271

[1] Basis: 228 trees. To get the volume of the entire stem in solid cubic feet, including bark, stump, and top, and excluding branches, multiply the number of cords in each case by 100.

TABLE 5.—*Volume of scrub pine in cords of peeled pulp wood, Maryland.*[1]

Diameter, breast high.	Height (feet).									
	30	35	40	45	50	55	60	65	70	75
	Volume (cords).									
Inches.										
4	0.013	0.015	0.017	0.019	0.021	.....	.....	.....	.....	.....
5	.019	.023	.025	.029	.031	0.035	.....	.....	.....	.....
6	.....	.032	.037	.041	.045	.050	0.055	0.060	.....	.....
7	.....	.043	.050	.056	.063	.069	.076	.082	0.089	.....
8	.....	.....	.065	.074	.082	.090	.098	.106	.114	.....
9	.....	.....	.....	.091	.101	.111	.121	.131	.141	0.151
10	.....	.....	.....	.112	.123	.134	.144	.156	.167	.177
11	.....	.....	.....	.....	.146	.158	.170	.183	.196	.207
12	.....	.....	.....	.....	.....	.183	.197	.210	.224	.236

[1] Basis: 228 trees.

REPRODUCTION.

The reproductive power of scrub pine is its most important silvical characteristic. It reproduces itself with the utmost ease, even on the poorest soils, and for this reason it has been able to hold its own in competition with faster-growing and longer-lived species with which it is associated. This superior reproductive power, even on sterile situations, is what recommends it as sometimes desirable for forest managment.

PRODUCTION OF SEED.

The seeds of scrub pine are ripe in November of the second year, and fall from the cones during the early part of the following winter.

The species is very prolific in seed bearing and the trees in the open may bear cones when 5 years old. Isolated trees in old fields bear abundant good seed almost annually from the age of 10 years. In

general abundant seed is produced every year over the entire range of the species. Very little seed is borne by young trees growing in thick, dense stands. But by the time such stands have reached 50 years the canopy has become broken, the crowns are isolated, and the trees bear many cones. It is important to note that border trees in dense stands, which receive much side light and have more crown-growing space, are good seed-producing trees; also, that if a dense stand be heavily thinned the trees remaining will produce abundant seed within two or three years.

DISSEMINATION OF THE SEED.

The natural dissemination of pine seed takes place principally through the agency of the wind, and to a slight extent through birds, animals, and water. The ripened cones open up in early winter, and the winged seeds drop out and are scattered by the wind. A tree with abundant cones will scatter its seeds plentifully to a distance of twice its own height, and sometimes seed is disseminated to a distance of a quarter of a mile in the direction of the prevailing wind. The nature of the dissemination is well illustrated where pine seed trees are situated along the edge of unused cleared land. Next the trees abundant reproduction takes place for from 50 to 100 feet; at from 100 to 300 feet the reproduction is still fairly uniform, but is very open; and beyond 300 feet it is very irregular and widely separated.

GERMINATING CAPACITY OF THE SEED.

The percentage of fertile seeds is very high. Prof. J. W. Toumey, who has experimented with the species in the nursery of the Yale Forest School at New Haven, Conn., says:

> In the seed bed we have found no difficulty in the germination of this species. So far as germination is concerned, it might be termed one of the pine weeds, as this species, jack pine (*Pinus divaricata*), and loblolly pine germinate with the greatest uniformity and the highest germinating per cent of all the pines I have ever grown.

The high germinating capacity is possessed by seeds produced by trees from the time they are only 10 years old until they are over-mature and declining.

The seed sometimes retains its vitality for several years after falling to the ground. Prof. S. C. Mason, of Berea College, Kentucky, cites a case in which a piece of ground cleared of scattering pines and left undisturbed had four years later 100 to 200 seedlings to the square rod (or 16,000 to 32,000 to the acre), from 1 to 4 years of age. Since there were no seed trees within less than 200 yards of the area, and these were to the leeward of the prevailing winds, it can not be doubted that the 1 to 4 year seedlings in this case sprang almost exclusively from seeds which fell four and more years previously.

Seeds collected from the trees and preserved under favorable conditions will retain their vitality from 5 to 10 years, though the percentage of germination will decrease with the age of the seed.

GERMINATION AND SEEDLING ESTABLISHMENT.

In the dense forest conditions may be favorable to seed germination, but the lack of light precludes seedling development, and scrub pine seedlings which become established will not survive more than a year or so unless the forest is opened up. On the other hand, under the canopy of a broken stand the reproduction is often excellent. The moisture conditions are there especially favorable to germination, while there is also sufficient light for seedling growth. Germination takes place readily on spots where the bare mineral soil is exposed, or where the organic soil of entirely decomposed humus is near the surface; but a thick layer of undecomposed leaves or duff makes reproduction almost impossible. A ground fire which destroys the thick layer of undecomposed litter is very favorable to reproduction, provided seed is disseminated over the area after the fire and before brush and weeds have a chance to occupy the ground.

Open situations, whether in the forest or on cleared areas, are most conducive to scrub pine reproduction. Germination from seed fallen in the open stands takes place under the same conditions as described for the broken forest, but the increased amount of light makes the seedlings more vigorous. On areas cleared by lumbering, pine seed germinates and the seedlings grow well, provided that there is not a dense growth of underbrush and weeds, or a thick layer of undecomposed litter. Fires after lumbering, when they burn the tops, brush, and undecomposed litter, are very favorable for reproduction. Reproduction from seed disseminated on idle farm land of all kinds is uniformly good. Unused plowed land, with soil directly exposed, is most favorable. Pasture lands with a very compact sod are least favorable, but if they are grazed with sheep or hogs, which break the sod with their hoofs, the chances for reproduction are improved. In regard to fertility of the soil, scrub pine is very unexacting, as long as the soil is sufficiently loose to receive and retain the seed or if there are cracks and crevices to serve the same purpose.

Where there are sufficient seed trees and favorable ground conditions an area will become well seeded in from three to five years.

SEEDLING DEVELOPMENT.

Scrub pine seedlings, once established, develop vigorously and rapidly. The roots go deep in the first year. The young seedling is thoroughly frost-hardy, and can stand exposure not only to cold but also to direct heat from the sun's rays.

The average rate of growth of pine seedlings which have abundant sunlight, is shown by Table 6.

TABLE 6.—*Height growth of scrub pine seedlings, Montgomery and Prince Georges Counties, Md.*[1]

Age.	Height.	Age.	Height.
Years.	*Feet.*	*Years.*	*Feet.*
1.....	0.9	6.....	7.8
2.....	2.0	7.....	10.5
3.....	3.2	8.....	13.2
4.....	4.5	9.....	15.0
5.....	6.0	10.....	17.0

[1] Based on measurements of 214 trees.

ENEMIES.

Injury to scrub pine, apart from that done in lumbering, comes most commonly through fire, wind, insects, and fungi.

FIRE.

Damage by fire varies with its nature and its severity, and with the age of the stand. In young seedling and sapling stands under 15 feet in height, fires are usually severe surface and crown fires which kill the stand outright. Small pole stands with trees over 2 inches in diameter breast high are subject to severe surface fires, which have an injurious effect on the future growth of the stand, but seldom kill many trees. In such stands, even when they are very dense, crown fires, which would kill the trees outright, seldom occur. Surface fires in large pole stands and mature stands do not appreciably damage the grown trees, as a rule, but they kill such pine reproduction as may be beneath them. The damage to single trees from surface fires varies directly with the thickness of the bark. The thicker the bark, the better is the fire-resisting power of the tree. Table 8 shows the average thickness of bark on the radius for trees of different diameters.

TABLE 8.—*Average thickness of bark at 4.5 feet from the ground for trees of different diameters.*

Diameter breast high.	Width of bark.	Basis.	Diameter breast high.	Width of bark.	Basis.
Inches.	*Inches.*	*Trees.*	*Inches.*	*Inches.*	*Trees.*
1.....	0.05	.....	8.....	0.35	13
2.....	.10	19	9.....	.38	8
3.....	.14	28	10.....	.41	2
4.....	.19	15	11.....	.43	5
5.....	.23	41	12.....	.45	.....
6.....	.27	15			
7.....	.31	20			166

Scrub pine has the power of recuperating readily from damage by fire, on account of resinous exudations which resist decay-producing agencies.

WIND.

Dense scrub-pine stands are very subject to wind, sleet, and snow-break. Scrub pine on abandoned farm land where the upper soil has been cultivated usually develops a rather flat, wide, and fibrous root system 1 to 3 feet in depth, and the tree is therefore not very windfirm. The danger from windfall is greatest to trees developed in dense stands, which are tall and have slender stems, and increases with the age of the stand. Unculled stands under 40 years of age are not much subject to windfall, but after that age the danger becomes rapidly greater, and the opening up of stands by lumbering adds to this danger. Trees growing in open situations are usually windfirm.

Great numbers of scrub pines throughout Maryland [1] were overthrown by the gales accompanying the violent storm of March 3–4, 1909. Both sleet and snow fell during this storm, and their weight was probably an important factor in the destruction of the trees. In many places in Maryland the havoc wrought by this storm is still apparent. A large proportion of the trees was killed outright, being entirely uprooted; others are still living in an oblique position.

Many large scrub pines were observed by the writer to have the young leaders broken off at their tops for a short distance, perhaps 2 or 3 feet. On examination these showed no evidence of fungous disease or insect injury, and the most natural conclusion is that the damage here is caused by ice and snow. Such injury of course opens up vulnerable spots in the tree where insects or fungi may enter later. The weight of ice and snow may also often be a factor of considerable importance in the overthrow of the whole tree.

INSECTS.

As a rule damage to scrub pine from insects is slight. The following statements concerning insect enemies of scrub embody information furnished by the Bureau of Entomology:

The tree is liable to the attack of several species of insects throughout its natural range, and more particularly in the southern portions. The two most important of these belong to a class of bark beetles of the family Scolytidæ. They are the destructive pine bark beetle *Dendroctonus frontalis* and the companion bark beetle *Tomicus avulsus*. Both of these species attack the inner bark and soon cause death. The prevalence of these insects varies from year to year, and in most cases of attack they destroy large areas of timber in one or two seasons, after which they perhaps disappear for a period of many years.

Both species are usually found working together. Usually, but not always, the destructive pine bark beetle takes the lead, this

[1] Observations by Arthur H. Graves, 1910.

depending upon the relative abundance of the two, as brought about by varying conditions.

Pine trees that have been injured by fire, wind, or lightning are usually attacked by one or both of these beetles, and such trees often serve as breeding places from which swarms emerge to continue their devastations in healthy forests. Lightning-struck trees are particularly subject to the attack of the destructive pine bark beetle, and in most cases when this insect is at all numerous, form a center around which a number of healthy trees are attacked and killed. Wind-felled trees and those scorched by fire are not so liable to attack by the destructive pine bark beetle and do not offer so good an opportunity for its increase. The companion bark beetle, which is much more common and generally distributed, is very often found breeding in these trees.

FUNGI.

The following statements in regard to fungi attacking scrub pine are based on information furnished by the Bureau of Plant Industry:

The scrub pine is not subject to fungous diseases which threaten widespread destruction. The tree is so short lived that little opportunity is afforded for the development of many of the fungous forms which attack other pines. Another reason for this comparative immunity may be that the tree is a specially vigorous species and can exude unusual quantities of resin that protects wounded surfaces.

The three most important diseases[1] which attack scrub pine are the burl disease (*Cronartium quercus*), causing peculiar knots or swellings on branches and on the main trunk of trees; the fungus *Trametes pini*, causing "heart rot;" and a leaf-casting disease or pine-leaf rust, which results in premature loss of the needles.

CHARACTERISTICS OF THE WOOD.

APPEARANCE.

Scrub pine has a light orange-tinged heartwood and a whitish sapwood. The wood is light, soft, and usually close-grained. It is difficult to distinguish the sawed lumber from that of shortleaf, loblolly, pitch, and other eastern yellow pines; but the sawmill men identify it by the following characteristics: Compact grain; large number of small, tight knots and rarity of large loose ones; small resin and pitch content; lightness in weight, and larger proportion of heartwood. These characteristics vary, however, and, as is the case with other eastern yellow pines, it is often impossible to distinguish the wood with certainty. A detailed study of these pines by Prof. Filibert Roth failed to bring out characteristics which could invariably be relied on.

[1] Observations by Arthur H. Graves, 1910.

MECHANICAL PROPERTIES.

It is seldom possible to cut clear lumber, or lumber fit for planing, from scrub pine, since the wood is usually knotty and will make only common and box grades of rough lumber, for which no high technical qualities are essential. In mechanical properties, such as stiffness and strength, scrub pine ranks with other yellow pines; and where the trees are large enough it pays best to cut them into dimension timbers, in which use small, tight knots are not a serious defect.

SEASONING.

Scrub-pine lumber is usually cut from small and comparatively young trees, and for this reason shrinks and warps badly in seasoning. It warps less, however, than loblolly and pitch pine timbers from trees of the same diameter, for it is of slower growth and has a higher percentage of heartwood. In southern Maryland, where loblolly, pitch, and scrub pines frequently grow together in even-aged forests, the last is always preferred for timbers in local house framing, on the ground that it is more durable and less liable to warp. Usually, however, it is cut into framing and put into the house in a green, unseasoned state, in the belief that the green timbers can not then warp much out of shape. Time is allowed for the framing to season before the house is completed. In seasoning, the wood of any of the yellow pines may shrink 10 per cent in volume and increase from 50 to 100 per cent in strength.

DURABILITY.

Scrub pine may be classed as a fairly durable pine. The heartwood is much more durable than the sapwood. Saplings used as fence rails have a life of three years, while heartwood rails last from six to eight years. The heartwood of scrub pine makes durable fence posts, but the sapwood is of no value for this use unless treated with preservatives such as creosote. Scrub pine, where cut locally for house framing, is preferred for sills over loblolly and pitch pines because of its greater durability, due to the fact that trees large enough to be cut for sills are composed mostly of heartwood, while loblolly and pitch pines of the same size have a large proportion of sapwood.

The best test of the durability of scrub pine has been its use for railroad ties. On a small branch division of the Pennsylvania Railroad, running from Clayton, Del., to Oxford, Md., scrub pine has been used to some extent for ties. The oldest section boss on that division informed the writer that 22 years ago he laid 1,600 scrub-pine ties. After six or seven years most of these were taken out, but

not in an unsound condition; the narrow rim of sapwood had commenced to peel off around the annual rings, and this badly littered up the track; but the heartwood of the ties was still perfectly sound. Two miles northeast of Greensboro the section boss showed two perfectly sound scrub-pine ties, composed entirely of heartwood, which had been put in the track 22 years before. There is no reason to question the record of the ties, since no more scrub-pine ties were used on this branch until two years ago. From this experiment it would seem that scrub pine makes a less durable tie than white oak, as durable a one as longleaf pine, and a more durable one than chestnut. But it should be almost entirely heartwood cut from trees 70 years of age and over. Scrub-pine ties are not adapted to main railroad lines, where there is constant and heavy freight traffic, because they do not hold spikes well enough. The wood is comparatively soft, so that the spike holes spread, especially on curves, where there is a heavy lateral impact against the rails.

SUITABILITY FOR CHEMICAL FIBER AND GROUND-WOOD PULP.

Since 1900 scrub pine has been rather extensively used in the manufacture of chemical fiber and ground-wood pulp. Two mills in Virginia use it in the mechanical or ground-wood process, and six or more mills in Pennsylvania, Delaware, and Maryland use it in the soda process, which produces chemical fiber.

Scrub pine is not good for ground-wood pulp. As with other yellow pines, the grindstones and screens are gummed up by the pitch and resin, which also clog the cylinder and felt of the wet machine. The pulp produced is inferior in quality, is difficult to bleach, and discolors when exposed to the air and light.

Yellow pines in general have twice as long fibers as those of most species, which is an extremely desirable quality for good chemical fiber. The high resin content is their chief drawback. Scrub pine is used with great success in the soda process, since the caustic soda extracts the resin and makes an excellent grade of chemical fiber. It is not suited to the sulphite process, because the sulphite solution is not strong enough to remove the resin. For chemical fiber scrub pine is superior to other yellow pines, because the wood is less resinous and for this reason does not require so strong a solution of caustic soda or so much pressure; the manufacture, therefore, is less expensive and the fibers are less impaired.

USES AND MARKET.

The purposes for which scrub pine is used may be conveniently divided into two classes: (1) Those which use young stands of pine under 40 years in age, where there are few trees as large as 9 or 10 inches in diameter breast high. This class includes the use of the

species for fuel, pulp wood, charcoal, excelsior, lagging (in mines), round fence rails, and small box lumber. (2) Purposes which require stands over 40 years in age, where there are many trees 10 inches and over in diameter breast high. Under this class comes the use of the species for lumber, railroad ties, piling, mine props, and split fence rails.

The principal use to which the species is put is probably for fuel for local consumption. The largest use of the tree is in Maryland, where the relative quantity of scrub pine, in comparison with other species, is greatest. A close approximation of the yearly cut of scrub pine in that State is as follows:

	Cords.
Pulp wood	20,000
Fuel (for shipment)	[1] 5,000
Charcoal	5,000
Lumber	[2] 24,000
Miscellaneous	1,000
Total	55,000

Where the trees are large enough for saw timber it always pays best to cut scrub pine into lumber. The kinds of lumber cut from the species are: Dimension stuff, mainly for house framing; rough boards, for barn siding, fence boards, etc.; rough box lumber; hogshead siding and heading; crating and heading; and staves for nail kegs. The cut of lumber is mostly used for boxes and crates. The cutting is done chiefly by portable mills, but to some extent by small stationary mills, and the output is, for the most part, used locally. The average value of scrub-pine lumber at the mills is about as follows: $12 per 1,000 feet for dimension stuff; $15 per 1,000 for boards 8 inches or more in width; $10 to $12 per 1,000 for boards under 8 inches in width; $8 to $9 per 1,000 for box lumber, crating, etc.

Since most of the lumber cut is either for boxes and crates or for dimension or common boards for local consumption, little grading is done. As far as could be ascertained, the lumber is never kiln-dried to be graded and to pass inspection under the North Carolina Pine Association rules. It is possible, however, that where it occurs in mixture with loblolly and shortleaf pines in southern Virginia and North Carolina it is sometimes cut and graded as "North Carolina pine," but it would seldom grade better than No. 3 (No. 1 Common) or Box.

Scrub pine is used locally for kindling and firewood, and is also shipped extensively to towns and cities, especially to Washington, Baltimore, and Philadelphia. The price f. o. b. local stations is $2.50 to $3 a cord and delivered in towns and cities it brings $3.50 or more per cord. In Washington the dealers pay $4 to $5 per cord

[1] Several times this amount used locally.

[2] Equal to 12,000,000 board feet.

delivered, and in Philadelphia $5 per cord and even higher. In common with other yellow pines, it is especially valuable for kindling wood.

Charcoaling is carried on extensively in southern Maryland and by several operators on the Eastern Shore of Maryland. It is done entirely in charcoal kilns, locally known as pits. The following figures on the charcoal industry refer to southern Maryland: From 5 to 25 cords of wood are stacked in a kiln, with an average of about 10 cords, and 40 bushels of charcoal are obtained per cord of wood. This charcoal is generally sold in carload lots to city merchants, and brings, on an average, $125 per carload of 1,300 bushels, f. o. b.

The use of scrub pine for paper pulp has already been mentioned. Its most extensive use for this purpose is by mills in southeastern Pennsylvania and eastern Maryland. In 1908 about 30,000 cords of scrub pine were used for pulp, with an average cost per cord, f. o. b. mill, of $6.60. This cost per cord may be roughly divided as follows:

Stumpage	$0.50 to $1.50
Felling, peeling, and stacking	1.25
Hauling	1.00
Loading on cars	.25
Freight	2.50 to 2.00
Contractor's profit	1.10 to .60
Total	6.60

The supply comes entirely from old-field growth of scrub pine, 25 to 50 years old, which has come up since the Civil War. The trees are felled, the branches are cut off, the bark is peeled, and the stems are sawed into 5-foot lengths. The peeling is done in the spring with a barking iron or "spud," and at other seasons with a drawknife. The whole stem is taken, down to about 2 inches inside the bark, but trees less than 5 inches in diameter, breast high, are seldom cut.

The stumpage, the value of standing scrub-pine timber, varies with the locality and size of the timber. The highest stumpage values that were noted were in southern New Jersey, in the vicinity of Millville and Bridgeton—$1 per cord for cordwood and $3 per 1,000 for saw timber. In Pennsylvania 50 cents to $1.50 per cord is paid for stumpage for pulp wood. In southern Maryland 50 cents to $1 is paid for cordwood stumpage, and $2 to $4 per 1,000 for saw timber. Farther southward stumpage values gradually decrease, and in North Carolina they are very low.

ADVISABILITY OF FOREST MANAGEMENT.

Silviculturally, scrub pine is excellently fitted for forest management for two reasons: First, because it occurs so largely in pure, even-aged, fully stocked stands, the most simple form of forest for

management; and second, because of the ease with which the establishment of a new crop by natural reproduction can be secured after the removal of the mature stand.

Forest management of pure second-growth stands of scrub pine to secure successive crops of timber is advisable on land of little value for agricultural or other purposes. It is also desirable to perpetuate the species where growing in mixture with hardwoods in the farmer's woodlot, provided there are no more valuable species of pine in the mixture which should be given preference. Scrub pine, furthermore, does good service in the renovation of worn-out agricultural land, and where trees of the species are sufficiently near they can be advantageously allowed to seed up such land and a crop of timber grown while the soil is being enriched.

By exercising a little care in cutting a mature stand of pure scrub pine, it will be possible under favorable conditions to procure a good stand of young-pine seedlings, which in 30 years will yield a crop of 26 cords of pulp wood to the acre, or if left 50 years will cut 17,700 board feet of 1-inch box boards per acre. The pulp wood should be worth in many places, at present prices, $1 a cord on the stump, or $26 per acre, and the box boards $2.50 per 1,000 on the stump, or $44.25 per acre.

As the timber supply of the United States is continually decreasing, it is reasonable to expect that stumpage prices in 30 to 40 years will be higher than these values, and the profits to be derived from forest management greater than present stumpage prices would seem to indicate.

PURPOSES OF MANAGEMENT AND ROTATION.

Before a system of management is decided upon it is necessary to decide the purpose for which the timber is to be grown. If it is for large stuff, such as saw timber, railroad ties, etc., more than 40 years will be required to grow a crop; if it is for small-sized material, such as pulp wood, charcoal, or fuel, the timber will be ripe in less than 40 years. Silviculturally and financially, a short rotation for scrub pine is more advisable than a long one. After 50 years the stand becomes more and more open, and the consequent increase of underbrush and weeds makes natural reproduction more difficult; also, with increasing age, the danger from snow and windfall becomes constantly greater and the tree is more likely to become attacked by insects and disease. Sixty to seventy years should, therefore, be considered, as a rule, the maximum rotation for scrub pine.

Table 9 shows the current annual increment and the mean annual increment for pure second-growth, fully stocked stands of scrub pine; or, in other words, the added volume put on during the last year at each stated age and the average for each year it took to attain that age.

TABLE 9.—*Mean and current annual increment for fully stocked stands of scrub pine.*

Age.	Mean annual increment.	Current annual increment.	Age.	Mean annual increment.	Current annual increment.
Years.	*Cords (fuel).*	*Cords (fuel).*	*Years.*	*Cords (fuel)*	*Cords (fuel).*
15	0.85	1.75	35	0.99	0.91
20	1.00	1.23	40	.97	.84
25	1.00	.98	45	.95	.75
30	1.00	.94	50	.93	.65

This shows that the most profitable rotation would be between 30 and 40 years, during which period the mean annual increment continues high. Before 30 years many trees in the stand are too small to make cutting desirable.

SUSTAINED ANNUAL YIELD.

To procure a sustained annual yield in pure scrub-pine forests is a comparatively easy matter. For example, if the woodlot owner desires to cut 100 cords annually for fuel, charcoal, or pulp wood from a pure pine forest to be managed on a 30-year rotation, where the average mean annual increment for the rotation is 1 cord per acre per annum, it would simply be necessary for him to clean-cut $3\frac{1}{3}$ acres a year of 30-year-old pine and reproduce this area. This would require a total of $3\frac{1}{3} \times 30$, or 100 acres of land, for a sustained annual yield of 100 cords on a 30-year rotation.

If there is not an even distribution of age classes, from 1 to 30 years, to start with, this distribution will be secured at the end of the first rotation by cutting and reproducing $3\frac{1}{3}$ acres each year. An irregular distribution of age classes naturally causes an irregular yield from the cuttings for the years of the first rotation. The $3\frac{1}{3}$ acres to be cut annually need not necessarily be in one body, but may be located in several different parts of the forest in order to facilitate reproduction.

The acquisition and management of forest land to supply a sustained annual yield is especially advisable for manufacturing concerns requiring a continuous yearly supply of wood. In regard to scrub-pine land, such a policy will often be advisable in the case of pulp companies, provided the land without the timber is sufficiently low in value. Both the land and the timber can often be bought for the price paid for the stumpage alone, and it is especially advisable for pulp companies using scrub pine to acquire cheap land for growing their supply of pulp wood.

NEW CROPS BY NATURAL REPRODUCTION.

Good natural reproduction of scrub pine in pure stands is best secured by nearly clean cuttings which leave from 5 to 10 seed trees to the acre. The trees selected to remain should be such as have the

best-developed crowns or are already full of cones, and should be evenly distributed over the area. Stands under 40 years of age, which are still very dense, will not produce much seed until the second or third year after cutting, but the isolated trees remaining should then bear profusely. A heavy thinning of a dense stand several years before the final cutting should considerably increase the amount of seed produced and is recommended where it will pay. The seed trees left can be cut and removed, if desired, as soon as the area is sufficiently stocked with seedlings, but special care must then be taken to keep fires and other sources of injury away from the young growing stock. Otherwise the seed trees will be left to develop into large timber trees.

Where it is desired to cut clean and it is not practicable to leave seed trees to be later removed, it is possible to obtain natural reproduction by cutting in strips. In this case the seed will be disseminated by the wind over the cleared strip from the border trees of the remaining stand, but the reproduction will not be so well distributed as in the scattered seed-tree method. It is best not to make the strips more than 100 feet wide, and they should always be cut on the leeward side of the stand and progress toward the direction from which the prevailing winter winds blow. From two to five years should elapse between the cutting of adjacent strips in a stand, so that each strip may be well reproduced from the neighboring stand.

It may sometimes be desirable to work a combination of the scattered seed tree and the strip methods. For instance, where it is wished to cut a much wider strip than 100 feet scattering seed trees may be left on the outermost part, while the part nearer the standing timber may be cut clean.

The principal obstacles to reproduction after cutting are: First, branches and tops left after lumbering; second, too thick a ground cover of undecomposed forest litter; and third, undergrowth, hardwood sprouts, and weeds. Usually, it will not be advisable to expend much money to overcome these hindrances, but much good can be done with only a small expenditure if it is carefully applied. In lumbering, it is well to pile the brush in narrow rows to take up the least possible ground space; this will also make the handling and transportation of the timber more convenient. Again, in logging operations, the more the soil is wounded and the undecomposed litter disturbed the better it is for the seed. The most effective instrument for improving the seed bed is fire, which, however, must be very carefully handled. It is always a good plan to burn the brush, after it has been carefully piled in heaps, for this complete destruction of the brush will be of great benefit. Where the undecomposed litter is especially thick, it is beneficial to burn the entire cut-over area with a ground fire, which destroys brush and litter, as well as undergrowth

and weeds. Such a burning had best take place in the fall of the year and when it is seen that the seed trees are full of cones from which seed will be scattered over the area in abundance the following year. Care should be taken to prevent the fire from spreading into adjacent standing timber, and especially into recently reproduced stands. The brush should be carefully raked from around the seed trees, in order to prevent damage to them.

Where scrub pine occurs mixed with hardwoods, as it often does in woodlots, it can best be maintained by making openings in the forest around pines which are good seeders, the size of these openings to be gradually increased as the pine reproduction springs up. In a mixed hardwood-sprout forest, managed on a clean cutting system, it will be necessary to get the pine started by this method of making openings several years before the clean cutting takes place, as the dense and rapid growth of sprouts after cutting would otherwise prevent the reproduction of pine.

IMPROVEMENT THINNINGS.

The object of thinning is the improvement of the growing condition of the stand before it is ripe for the final cutting, by the removal of a portion of the trees in stands too dense for the best development of the stand as a whole. In scrub pine stands thinnings are recommended only where they will yield a net return in money on the wood removed, or will at least pay for the work done.

The trees to be removed in thinnings can best be indicated by the following classification of trees composing stands:

(1) Dominant and codominant classes. Trees which make the upper crown cover. (*a*) Dominant—trees with well-formed crowns. (*b*) Codominant—trees with uneven crowns.

(2) Intermediate and suppressed classes. Overtopped trees which have fallen in growth below the upper crown cover. (*a*) Intermediate trees—with crowns free to light. (*b*) Suppressed trees—with crowns directly shaded but thrifty.

(3) Dying or dead.

The object of the thinning should be to favor trees of the dominant class by the removal of trees of other classes which are hindering their proper development, and which will be mainly codominant and intermediate trees. Codominant trees should be favored over intermediate and suppressed trees. A moderate thinning will consist of the removal of all intermediate and suppressed trees, while a heavy thinning will include many codominate trees. Diseased and dying trees of any class and dead trees should always be removed.

In very dense stands early thinnings, even before 20 years of age, are especially helpful, but are often very difficult to make. It will be best in such thick young growth not to try to make regular thinnings,

but simply to cut parallel straight lanes through the stand about 5 feet in width and at intervals of about 10 feet, with a maximum removal of one-third of the stand. The clear cutting of lanes in this manner makes it possible to fell trees with comparative ease, while with a selective method it would be a case of continual and difficult lodging and hanging.

PROTECTION.

Harm from insects and diseases can be combated by cutting out all infested and diseased trees in the fall and winter, and stripping off and burning the bark, as well as the branches and tops, to destroy the insects or fungi, and thus prevent the infection of other trees. It is possible to cut scrub stands without danger from insect infestation to trees left by doing the cutting some time between November and April, and burning all slash left after cutting.

Danger from windfall is lessened by cutting toward the prevailing wind, as recommended in the strip method of cutting. The shorter the rotation, the less will be the danger of windfall. Scattered seed trees will always be in danger from windfall. A thinning previous to the final cutting would not only increase the seed production of the remaining trees, but also cause them to develop more wind-firm root systems, so that the trees selected for seed would be less subject to windfall.

Fire is by far the most important cause of damage to the forest, and the one most necessary to be guarded against. The greatest injury by fire is to young seedling and sapling stands, which are often killed outright, and these are therefore in need of protection from fire. The larger the stand, the less it is liable to serious injury by fire; but it is always best that fire be kept out entirely from stands of all ages and sizes.

Fire patrols should be maintained, especially in the spring before the leaves come out and in the autumn after the leaves have fallen, and all fires should be put out as soon as found. Since the forests of scrub pine occur so largely in small areas, broken up by fields and roads which act as barriers, extensive fires are rare.

EXTENSION.

Scrub pine extends naturally over unused fields wherever seed trees are in the vicinity, and it is often advisable to allow it to take possession of worn-out farm land. But where it is wished to extend the forest artificially, it will pay best in most cases to grow some more valuable species than scrub pine. On bare, sterile soils, however, not well suited to the growth of better species, it may be well to sow scrub pine, which thrives where many other species would fail. Again, when seed can be easily and cheaply collected, artificial

sowing may be used to help out the natural extension over pastures and fields. It is probable that sowing in seed spots will be successful with this species, which would be cheaper than planting. The seed spots should be about 1 foot square, and well grubbed up so as to expose and pulverize the surface soil, and to make it loose to a depth of several inches. Three to five seeds should be sown in a spot, covered to a depth of one-eighth to one-quarter of an inch, and stepped on lightly with the ball of the foot. To produce well-stocked stands the spots should not be more than 6 feet apart. The sowing should be done in spring, after the buds of the trees begin to swell. Fall or winter sowing gives the seed a longer time in which to deteriorate. Transplanting of wild stock 1 to 2 years old may be practiced in some cases successfully and cheaply.

PREVENTION OF EXTENSION.

Wherever it is associated with shortleaf or with white pine, scrub pine tends to replace them in the second growth, after lumbering. In such cases it is advisable to eradicate scrub pine by carefully cutting out all trees of the species which are bearing or are likely soon to bear seed, and by leaving seed trees of shortleaf or of white pine to restock the cut-over area. Scrub pine should be allowed to extend itself only where it is not possible or practicable to secure reproduction of more valuable species.

SUMMARY.

The species is especially adapted to sterile soils and worn-out farm land. It occurs principally on idle farm land, where it frequently forms pure, even-aged, fully stocked stands. It is a fairly rapid grower in early years, but as a rule is short lived, and does not reach large dimensions. It reproduces itself with the utmost ease, and rapidly extends itself over idle cleared land wherever seed trees are at hand.

Since the prevailing growth of the species is small, the wood is principally used for fuel, pulp wood, and charcoal. Wherever it is large enough, it is cut for lumber for local consumption, which is the most profitable use for such timber. Trees of the species which have come up in open stands have little value; the growth must be in fairly dense stands to be of commercial value. The species is better adapted for pulp wood than are the more resinous yellow pines. It has also been successfully used for railroad ties, and could be greatly improved for this purpose by creosoting, to which it is very well adapted.

Forest management, as a rule, is advisable for pure second-growth scrub-pine land, where the land is of little value for agricultural or other purposes. Such stands can be easily reproduced, and yield a

fair revenue after cutting. Where mixed with hardwoods it is a good tree to maintain on the woodlot, provided there are growing no more valuable species of pine to be encouraged. A short rotation of 30 to 40 years is silviculturally and financially preferable to a long one. Scrub pine is adaptable to management for a sustained annual yield. Improvement thinnings are advisable wherever they can be made to pay for themselves. The natural or artificial extension of scrub pine over additional areas of worn-out farm land or barren land is sometimes advisable where seed trees are abundant and natural seeding will take place, or seed can be collected at small cost, and where it would be difficult or too expensive to secure the growth of better trees. On the other hand, where scrub pine competes with more valuable species for occupation of the soil, as it does with shortleaf pine in parts of Virginia, it should be eradicated as much as possible and prevented from seeding up cut-over areas or abandoned agricultural land.

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